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Statement of
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before the

Subcommittee on Space and Aeronautics
Committee on Science and Technology
U. S. House of Representatives

Mr. Chairman and Members of the Subcommittee, thank you for the opportunity to appear before you today to discuss the status of the Space Shuttle and the International Space Station (ISS). It is a pleasure to report to you the good year we have had in the human spaceflight program, and the progress we are making in support of the Nation's exploration goals. I would like to give you an update on the Space Shuttle and ISS programs, discuss the challenges over the next 5 years, and share with you some of our success stories.

Only a few weeks ago, the Shuttle made an unscheduled stop at the Rick Husband Amarillo International Airport in Texas. Resting atop its modified Boeing 747 carrier, the Shuttle *Atlantis* was returning to NASA's Kennedy Space Center (KSC) in Florida following a successful mission to the ISS. While the Shuttle waited in sunny Amarillo for better weather on its planned flight to KSC, television news coverage showed hundreds of people gathering around the airport perimeter to catch a glimpse of the Shuttle. A spontaneous American pilgrimage ensued. Some drove hours and took time off work. Parents brought their children and paid homage to their space program. The children and the grownups were in awe at the sight of *Atlantis*.

Amarillo should remind all of us that the American public, in the face of challenges, even tragedy, values exploration and the contributions of the Space Shuttle and the ISS. NASA captures the imagination of Americans to reach farther, create opportunities, and live beyond the confines of our environment.

International Space Station (ISS)

With each new assembly and logistics flight, with each additional year of continuous habitation, the ISS continues to grow in both size and capability. In the second half of 2006, NASA successfully completed three Space Shuttle missions, including ISS-12A (STS-115) and ISS-12A.1 (STS-116), which continued ISS assembly with the addition of the P3, P4, and P5 truss segments. In June 2007, ISS-13A (STS-117) added the S3 and S4 truss segments, further boosting available power on the ISS to 42 kilowatts. This flight allowed for the final step in activating the permanent power and thermal systems on ISS. All of these new systems continue to operate flawlessly. As of the ISS-13A mission, the ISS is now almost 250 tons, which represents approximately 57 percent of the mass of the ISS once it is completed in 2010. The pressurized volume has grown to 14,509 cubic feet, representing approximately 45 percent of the final configuration, and ten of the twelve truss segments and three of the four U.S. solar arrays are already on-orbit.

Our state of preparedness for the upcoming missions is also very high, with the ground-based teams exercised and fully engaged as a result of the recently completed orbital assembly operations. In the second half of calendar year 2007, three more Space Shuttle missions remain on schedule to deliver the S5 truss segment, Node 2, and the first partner laboratory. The flight readiness review for the first of these missions, ISS-13A.1 (STS- 118), will start tomorrow, July 25, 2007, in preparation for a launch no earlier than August 7. Together, ISS-13A.1 and the subsequent mission, ISS-10A (STS-120), will complete the major U.S. pressurized elements of the Station, after which we will turn our attention to fulfilling commitments to our international partners.

Europe, Japan and Canada are preparing for an exciting period in human space flight as their elements launch over the next year. These will include the European laboratory *Columbus*, the Japanese laboratory *Kibo* and its pressurized logistics module, and the Canadian dexterous remote manipulator system *Dextre*. All of these elements have been delivered to KSC and are going through their final pre-flight checkouts and launch preparations. In addition, the European Autonomous Transfer Vehicle is scheduled for its maiden flight in early 2008.

The ISS is also proceeding well along the path towards seeing the crew size expand from three to six in 2009. The U.S.-built oxygen generation system (OGS) has been integrated in the U.S. laboratory *Destiny*, and successfully demonstrated its ability to produce oxygen on July 13. The water recovery system has completed development and is awaiting launch in late 2008, thus completing the regenerative environmental control and life support system.

In addition to the Space Shuttle assembly missions, we must not forget about the critical work being done on ISS every day. Since the last Space Shuttle mission, 1.8 million lines of software have been updated. This major update occurred with little fanfare but was critical to future assembly. In addition, NASA preparations for STS-118 include a spacewalk by Expedition 15 astronauts Fyodor Yurchikhin and Clay Anderson to replace a failed remote power converter and clearing the P6 for movement on STS-120 by jettisoning the early ammonia servicer. Building, servicing, and utilizing the ISS is a twenty-four hour a day, seven day a week job for the ground controllers and crews – exactly the type of training that is needed to prepare our teams and our systems for long-duration missions to the lunar surface, to Mars, and beyond.

The Congressionally-mandated ISS Independent Safety Task Force (IISTF) completed its work in February and found the program to be "robust and sound…with respect to safety and crew health." The Task Force made seven principal recommendations that would further strengthen the ISS program by increasing the likelihood of mission success and mitigating risks to crew safety. NASA has taken action on those principal recommendations that are within our ability to effect, such as installation of Russian-built debris panels on their service module to reduce the risk of micrometeoroid and orbital debris impacts. We continue to monitor the performance of the debris protection system through regular inspections with the ISS robotic arm, through Space Shuttle "fly arounds," and during extra-vehicular activities (EVAs) performed by the astronauts. All debris impacts seen so far are within the design capability of the ISS and are being recorded to improve our analytical debris models.

With respect to the remaining IISTF recommendations, NASA has implemented a workforce strategy to ensure the Agency retains critical skills necessary to sustain the ISS. The Agency also remains on track to support completion of the current Space Shuttle flight plan for ISS assembly. The Agency may fly up to two additional ISS logistics flights if they are deemed necessary and can be flown before the end of 2010. The IISTF recommendation to comprehensively review the European ATV logistics flight has been closed based on the review completed January 8, 2007.

We have also completed development and installed the first of two Space Station-to-Shuttle power transfer systems (SSPTS) on the orbiter *Endeavour* for testing and verification on ISS-13A.1. SSPTS allows power generated by the ISS solar arrays to be transferred to, and used by, the Space Shuttle while docked to the ISS. This capability will allow the orbiters to remain docked at the ISS an additional three to four days, thereby extending our ability to conduct planned and unplanned EVA activities during the very complex assembly operations that lie ahead.

We continue to employ the Station's unique attributes for the advancement of science and technology. During Expedition 14, there were thirty-two U.S. experiments conducted, and in Expedition 15 another twenty-one are underway. These range across the life and physical sciences, and highlight growing interest in use of the microgravity environment to advance knowledge in the fields of microbiology, genetics, bacteriology, and the metabolic nature of chronic human diseases. The upcoming ISS-13A.1 assembly mission will include research designed by Amgen, Inc., a leading Fortune 500 human therapeutics company in the biotechnology industry.

A primary focus for U.S. research on ISS is to find ways of mitigating risks associated with long-duration human exploration of the Moon and Mars. These risks include a broad range of physiological and psychological issues, including those associated with extended operations in reduced and microgravity environments (such as accelerated bone loss, adaptation to changing gravity loads, muscle loss, changes to cardiovascular functions, altered immune system responses, and drug effectiveness), guaranteeing proper nutrition and medical support while operating far from Earth, improving ergonomics and human-machine interfaces, and ensuring effective crew performance and cohesiveness. The ISS is critically important to the success of future long-duration missions specifically because it is the only facility that combines the ambient environment and research capabilities needed to understand the extent of these risks with the ability to develop and test appropriate countermeasures.

Research underway during the assembly phase is a prelude to future operation of the U.S. portion of the ISS as a National Laboratory as directed by Section 507 of the NASA Authorization Act of 2005 (P.L. 109-155). On May 30, 2007, NASA submitted to the Subcommittee a report required by Section 507(c) which outlined the Agency's plans for operating the ISS as a National Laboratory, including progress in implementing a broad ISS applications development initiative and the prospects for productive utilization of the ISS in the post-assembly timeframe. This initiative is just beginning in anticipation of completing ISS assembly in 2010, and holds the promise for highly productive public and private partnerships in research and development – provided that needed space transportation services are available in the future.

With respect to the logistical requirements for ISS operations and utilization after the retirement of the Shuttle, on March 1, 2006, as required by Section 505 (c)(2) of the NASA Authorization Act of 2005 (P.L. 109-155), NASA submitted to the Subcommittee a report outlining contingency plans for logistics and on-orbit capabilities for the ISS. These plans include using the Space Shuttle to preposition key spares, working with industry to demonstrate and then utilize commercial services for transporting crew and cargo to the ISS, using the Crew Exploration Vehicle to supply the ISS if commercial services are unavailable, and working with International

Partners to develop additional capacities in the event they become necessary. As of today, our plans remain the same as outlined in this report,

Space Shuttle

As we reflect upon the four successful Space Shuttle missions (STS-121, -115, -116, and -117) conducted in the last 11 months and get back into the rhythm of launching every couple of months, it is important to keep in mind that flying these vehicles is neither easy nor routine.

The Space Shuttle is an extraordinarily capable transportation system, and it takes an equally extraordinary team to operate that system safely, time after time, mission after mission. When you are working on a construction site that is 200 nautical miles above the Earth's surface and that is dominated by hard vacuum and extreme temperature fluctuations, preparedness is essential for mission success. At Kennedy Space Center alone, hundreds of thousands of work-hours are needed to prepare the hardware for flight. For every hour a crewmember spends outside on an EVA during a mission, seven hours are spent in the training pool at the Neutral Buoyancy Laboratory at the Johnson Space Center in Texas practicing skills and choreographing each maneuver. The contributions of thousands of highly trained people from across our Nation and around the world need to be seamlessly brought together to develop integrated mission operations plans with our international partners, to properly equip and train ground and flight crews, and to coordinate launch and mission support activities across six continents.

Our two biggest challenges over the next few years are maintaining the hard-won critical skills we need to safely fly out the Shuttle manifest and helping our workforce make a smooth transition to the post-Shuttle era. To address this concern, we have benchmarked other enterprises that have shut down major operations to implement best practices to retain our critical people. Although financial incentives can play a key role in employee retention, our best tool to retain employees is to provide meaningful and challenging work. We are doing this now through the challenging and exciting ISS assembly missions. Looking towards the future through retraining, job rotations, and other mechanisms, we are working hard to give people an opportunity to transition the skills learned flying the Shuttle to the design and operation of the next generation of vehicles.

When we fly systems as capable and as complex as the Space Shuttle and the ISS in such a dynamic environment, we have to always be prepared for the unexpected and agile enough to react quickly and effectively. For example, weather considerations often play an important role in our mission planning, and severe weather conditions can have a significant impact on our operations. Such was the case on February 26, when an intense hailstorm struck the STS-117 vehicle as it was sitting on the launch pad and caused extensive damage to the foam on the external tank.

That damage forced a rollback to the Vehicle Assembly Building, where crews could build work platforms for controlled access to the vehicle. Within three months, NASA engineers and technicians analyzed over 6,000 discreet areas of foam damage, developed special tools and techniques and made repairs where necessary. Though the damage to the tank was extensive, our experience with various external tank foam repair techniques – combined with the powerful analytical tools developed during Return to Flight activities – enabled us to do the analysis and repairs swiftly and with a high degree of engineering confidence.

Over the coming years, NASA will need to remain agile and focused on technical excellence if the Agency is to complete the important work that is in front of us. NASA has 13 missions on the manifest over the next 38 months, including 12 assembly flights to the ISS and a servicing flight to the Hubble Space Telescope. NASA could potentially also fly up to two contingency logistics flights to the ISS to preposition spares for the post-Shuttle era if these flights are deemed necessary and can be flown before the end of 2010. Even if NASA flies both contingency flights, the pace (which equates to four or five flights a year between 2008 and 2010) would still be consistent with the Agency's recent experience in flying three Space Shuttle missions (STS-121, -115, and -116) during the last six months of 2006.

Barring further significant disruptions, NASA should be able to recover from the STS-117 launch delay and be back to plan by mid-2008. The rule that we will always follow is that, "We will fly only when we are ready to fly. As always, the safety of our crewmembers is our paramount consideration."

The next mission, STS-118 (ISS-13A.1), to deliver and install the S5 truss segment, is in the final stages of preparation at Launch Complex-39A at KSC. Although STS-118 is targeted to be launched on August 7, we are mindful that the Phoenix Mars Lander Mission, scheduled to be launched from Cape Canaveral on a Delta II on August 3, has a 20-day planetary launch window that, once it expires, does not return for two years. STS-118 is the first flight of *Endeavour* since the fall of 2002, and the vehicle has received sufficient structural inspections and modifications to enable it to fly through 2010 without additional major modifications. During this flight, *Endeavour* will, for the first time, use the Global Positioning System for navigation purposes and power generated by the ISS solar arrays while docked to the ISS.

Two more missions are scheduled for flight this year. During STS-120 (ISS-10A) in October, *Discovery* will carry Node 2 to the ISS. Installing Node 2 will be extremely challenging both during the Shuttle mission and afterwards, with two EVAs scheduled to reposition the node after the Shuttle departs ISS. While the next mission still may need to be moved slightly, the December launch of STS-122 (ISS-1E) will see *Atlantis* transporting the European Space Agency's *Columbus* module.

As we continue our preparations for these upcoming flights, we are also continuously improving the overall safety of the Space Shuttle system. Substantial progress has been made in preparing two important upgrades for deployment into the fleet – the Advanced Health Monitoring System (AHMS), and redesigns to the thermal protection system on the external tank. The first, AHMS, is an upgrade to the Space Shuttle main engines, one of the most complex elements of the Space Shuttle system and one of our highest areas of interest from an overall probabilistic risk perspective. Specifically, AHMS improves our ability to monitor the performance of the Space Shuttle main engines during flight and, under certain circumstances, can initiate a controlled shutdown of a suspect main engine during ascent. An AHMS controller was flown for the first time in a passive, monitoring mode on one engine for STS-116 in December, 2006, then in an active (control) mode on one engine for STS-117 in June. AHMS controllers will be installed and in active mode on all three engines starting with STS-118.

A second improvement effort has focused on continuing to reduce the debris risk posed by foam being released from the external tank during ascent. In addition to our continuous foam application process improvement efforts, we recently completed a critical design review for changes to the liquid hydrogen ice-frost ramps and liquid oxygen feedline bracket. The new ice-frost ramp design will be implemented on External Tank 120, currently scheduled to support mission STS-120 later this year. The ice-frost ramp and the feedline bracket redesigns will be flown together on External Tank 128, which will be flown before the Hubble Space Telescope servicing mission currently scheduled for September 2008.

Summary

I believe that we are living in one of the most exciting eras so far in the history of space exploration. There are challenges in front of us, to be sure, and we will have to be ready to respond to the unexpected. But no one is more prepared to confront and overcome these challenges than the international team of engineers and technicians that are flying the ISS and the Space Shuttle today. And as we look towards future flights to the Moon, Mars, and beyond (where self-sufficiency, independency and, above all, adaptability will mark the difference between success and failure), I can think of no better preparation than the work we're doing right now to complete the ISS and take best advantage of this unique research facility.

I would be pleased to respond to any question you or the other Members of the Subcommittee may have.

Biography of
William H. Gerstenmaier
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William H. Gerstenmaier is the Associate Administrator for Space Operations. In this position, Gerstenmaier directs NASA's human exploration of space. He also has programmatic oversight for the international space station, space shuttle, space communications and space launch vehicles.

Formerly Gerstenmaier was the program manager of the International Space Station Office at NASA's Johnson Space Center in Houston, and was responsible for the overall management, development, integration, and operation of the International Space Station.

In 1977, Gerstenmaier began his NASA career at the Glenn Research Center in Cleveland, Ohio, performing aeronautical research. He was involved with the wind tunnel tests that were used to develop the calibration curves for the air data probes used during entry on the space shuttle.

Beginning in 1988, Gerstenmaier headed the Orbital Maneuvering Vehicle (OMV) Operations Office, Systems Division at Johnson Space Center, where he was responsible for all aspects of OMV operations. Subsequently, he headed Space Shuttle/Space Station Freedom Assembly Operations Office, Operations Division and was Chief, Projects and Facilities Branch, Flight Design and Dynamics Division.

Gerstenmaier also served as Shuttle/Mir Program Operations Manager from 1995 to 1997. During this time he was the primary liaison to the Russian Space Agency for operational issues and negotiated all protocols used in support of operations during the Shuttle/Mir missions. In addition, he supported NASA 2 operations from Russia, January-September 1996.

In 1998, Gerstenmaier became manager of Space Shuttle Program Integration, where he was responsible for the overall management, integration, and operations. In December 2000, he was named deputy manager of the International Space Station Program.

Gerstenmaier received a bachelor of science in aeronautical engineering from Purdue University in 1977 and a master of science degree in mechanical engineering from the University of Toledo in 1981. In 1992 and 1993, he completed course work for a doctorate in dynamics and control with emphasis in propulsion at Purdue University.

Gerstenmaier is the recipient of numerous awards, including three NASA Certificates of Commendation, two NASA Exceptional Service Medals, a Senior NASA Outstanding Leadership Medal, and the Presidential Rank Award for Meritorious Executives. He also was honored with an Outstanding Aerospace Engineer Award from Purdue University, and additionally, twice by Aviation Week and Space for Outstanding Achievement in the Field of Space.

He is married to the former Marsha Ann Johnson. They have two children.